

**Evaluating the effect of meta-cognitive beliefs about angry rumination  
on anger with cognitive bias modification**

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## **Abstract**

Since the publication of Susan Nolen-Hoeksema's (1991) seminal Response Style Theory of depressive rumination, a wealth of research has demonstrated that rumination plays an important role in the onset and maintenance of depression. More recently, rumination has been examined within the context of anger, and findings have suggested that ruminating about anger-inducing events heightens or maintains anger and increases aggression. Given these unhelpful effects, why do people ruminate in response to anger? The current experiment examined the potential role of positive beliefs about rumination in maintaining this process. We tested the hypothesis that positive beliefs about ruminating in response to anger-provoking events would lead to increased levels of anger and aggression. Participants engaged in cognitive bias modification (CBM) training intended to induce positive or negative beliefs about rumination. Next, they were presented with anger-provoking scenarios and asked to rate their predicted levels of anger and aggression in response to these scenarios. After CBM training, all participants showed a positive belief bias towards rumination; however, this bias was more pronounced in the positive beliefs condition. Unexpectedly, participants in the positive beliefs condition predicted that they would have lower levels of anger than participants in the negative beliefs condition, although this difference was reduced to a trend when implicit preference for emotional expression was controlled. The unexpected findings suggest novel testable hypotheses, for which concrete suggestions are provided.

## Introduction

Rumination is a type of repetitive and perseverative thinking. In the context of depression, the focus of rumination is often on the causes and consequences of one's negative mood state (i.e., depressive rumination; e.g., Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008; Watkins, 2008). The publication of Susan Nolen-Hoeksema's (1991) seminal model – the Response Style Theory of depressive rumination – sparked a now extensive literature on this topic. Subsequent work inspired by response style theory has convincingly implicated rumination in the onset and maintenance of depression. Although rumination has been studied most extensively in the context of depression, this cognitive process has received increasing empirical attention in the anger literature, including a seminal paper by Rusting and Nolen-Hoeksema (1998). In studying angry rumination, i.e., rumination in response to anger-provoking situations, researchers have drawn on the theory, methods and approaches to studying rumination that were pioneered by Professor Nolen-Hoeksema and her colleagues. We hope to convey this wider influence of Professor Nolen-Hoeksema's work in the psychological literature by contributing a paper that describes an experiment that manipulated beliefs about angry rumination. We hope that this will be a small yet fitting gesture of acknowledgement of the tremendous breadth of impact of her work across our field.

*Angry rumination* is defined as “perseverative thinking about a personally meaningful anger-inducing event” (Denson, 2013, p. 103). Rumination in response to anger and rumination in response to sadness have been found to represent two distinct constructs (Peled & Moretti, 2010). That is, when participants completed anger rumination and sadness rumination questionnaires, factor-analysis revealed anger rumination and sadness rumination were two distinct sub-factors of a general rumination factor, which independently predicted aggression and depressed mood, respectively. The items in the two rumination questionnaires were identical, except for the relevant emotional words. For example, ‘I keep thinking about

the reasons for my anger/sadness’, and ‘When something makes me angry/sad, I turn this matter over and over again in my mind’. There is increasing empirical evidence that rumination in the context of anger plays a key role in increasing or maintaining levels of anger as well as augmenting aggression (e.g., Bushman, 2002; Anestis, Anestis, Selby, & Joiner, 2009; Peled & Moretti, 2010; Vasquez, Pedersen, Bushman, Kelley, Demeestere, & Miller, 2013). In an early study in this area, Rusting and Nolen-Hoeksema (1998) found that rumination exacerbated anger whereas distraction decreased it, and concluded that anger rumination and rumination in response to depression share a focus of attention on the causes of the negative affective state. The findings of subsequent experiments have suggested that dwelling on anger-inducing experiences (i.e., angry rumination) may be particularly harmful because it increases aggression over extended periods (up to 8 hours), even toward innocent individuals (Bushman, 2002; Bushman, Bonacci, Pedersen, Vasquez, & Miller, 2005; Denson, Pederson, & Miller, 2006). In a recent study, Denson et al. (2012) instructed participants to recall an anger-eliciting memory and then engage in either rumination, cognitive reappraisal, or distraction, or participants were not given instructions (i.e., in the control condition). Participants who ruminated reported maintained anger, while those in the remaining conditions reported reductions in anger levels. Consistent with these laboratory findings, there is evidence that chronic angry rumination is related to increased self-reported domestic abuse and road rage (Denson et al., 2006; Suhr & Nesbit, 2013).

These adverse outcomes of rumination in the context of anger prompt a critical question: why do people continue to ruminate when this style of thinking can have such detrimental effects? One factor that has been linked to the persistence of rumination in response to depression is the tendency to hold metacognitive beliefs about the perceived benefits of engaging in ruminative thought (e.g., *rumination helps me to solve my problems*; Lyubomirsky & Nolen-Hoeksema, 1993; Papageorgiou & Wells, 2001; Watkins & Moulds,

2005). In an experimental study, Moulds, Yap, Kerr, Williams, and Kandris (2010) found that participants who held high levels of positive beliefs about the advantages of engaging in rumination about their depressed mood state reported more rumination following the completion of a laboratory-based stressor task (i.e., solving insoluble anagrams under time pressure) than did participants with low levels of such beliefs. Interestingly, this between-group difference was observed regardless of whether participants received positive or negative feedback on their performance on the task or even when no feedback was given, confirming the role of metacognitive beliefs in increasing the likelihood of rumination.

To date, the question of whether beliefs about the benefits of angry rumination play a role in the persistence of rumination about anger-eliciting events has been minimally addressed (Denson, 2013). Anger and sadness differ on a number of dimensions including approach-avoidance and arousal (e.g., Carver & Harmon-Jones, 2009). Thus, it is important to examine the extent to which beliefs about anger and angry rumination influence the likelihood of engaging in rumination, and associated affective responses – as is the case for depressive rumination. In the one study reported in the literature that investigated beliefs about anger rumination, Simpson and Papageorgiou (2003) qualitatively assessed ten individuals with anger control problems with a semi-structured interview. All participants reported rumination during and following an anger-eliciting event and eight of the participants indicated that they held positive metacognitive beliefs about rumination. The authors noted that the themes of these beliefs included self-justification and attempts to gain insight and understand difficulties (Simpson & Papageorgiou, 2003). Some of these themes are particularly relevant to angry rumination, but others could apply to depressive rumination as well.

This suggestive evidence of the role of metacognitive beliefs in driving angry rumination underscores the need for clinical interventions that modify these beliefs in order

to reduce the likelihood that clients will engage in rumination. One experimental procedure with scope to provide a pre-clinical experimental test of the efficacy of such an approach is cognitive bias modification (CBM; Mathews & Mackintosh, 2000; Mathews & MacLeod, 2002; see also Holmes, Mathews, Dalgleish, & Mackintosh, 2006; Holmes, Coughtrey, & Connor, 2008; Watkins, Moberly, & Moulds, 2008; Salemink, van den Hout, & Kindt, 2009). CBM is a computerised methodology that has enabled researchers to address questions of causality by providing systematic training in order to modify the direction of maladaptive habitual cognitive biases. Participants are typically presented with training conditions in which they are exposed to repeated presentations of exemplar stimuli that are designed to manipulate the cognitive bias relevant to the condition under examination. Two earlier experiments showed that CBM targeting metacognitive beliefs and appraisals in regard to sad or distressing intrusive memories modulated the frequency of these memories (Lang, Moulds, & Holmes, 2009; Woud, Holmes, Postma, Dalgleish, & Mackintosh, 2012).

To summarise, there is evidence that positive metacognitive beliefs about the advantages of rumination are associated with the tendency to ruminate (Lyubomirsky & Nolen-Hoeksema, 1993; Papageorgiou & Wells, 2001; Watkins & Moulds, 2005). In turn, rumination about angry mood has been found to fuel this potentially dysfunctional and harmful mood state (Bushman, 2002; Denson et al., 2006; Denson et al., 2012). As demonstrated by two experimental studies (Lang et al., 2009; Woud et al., 2012), CBM can be used to modify beliefs about cognitive processes such as intrusive memories. Collectively, these findings give rise to the hypothesis that a CBM procedure may also be effective in changing metacognitive beliefs about the use of rumination in the context of anger, and may in turn reduce angry mood.

In the present study we tested the hypothesis that manipulating metacognitive beliefs about rumination would modulate subsequent levels of anger and aggression. Specifically, we

compared the impact of CBM training that was designed to induce positive versus negative metacognitive beliefs about the benefits of rumination in response to anger. After the training, we measured participants' predicted aggressive responses to hypothetical anger-evoking scenarios. We predicted that participants who were trained to hold positive beliefs about rumination would endorse higher levels of anger and aggression in response to these scenarios than participants who were trained to adopt negative beliefs about rumination. To rule out group differences in other forms of emotion regulation, and to gauge the specificity of the training effect, we included baseline measures of reappraisal, suppression, and implicit preferences for emotion regulation.

## **Method**

### **Participants**

A total of 110 undergraduates were recruited from the first year participant pool in the School of Psychology at the University of New South Wales (UNSW). Data from 11 participants were not obtained due to computer malfunction. The final dataset included 99 participants with a mean age of 19.16 years ( $SD = 2.11$ ), of which 68 were women. English was the native language of 74 of the participants whereas the other 25 participants had a different native language. Their level of English was sufficient to be admitted as a student at UNSW. Participants were randomly assigned to two experimental conditions, with 49 participants in the *positive beliefs* about rumination condition and 50 in the *negative beliefs* about rumination condition.

### **Materials**

**Depression Anxiety Stress Scales (DASS).** The DASS (Lovibond & Lovibond, 1995) is a 42-item self-report instrument that indexes anxiety, depression and stress over the previous week on a 4-point scale (0 = *did not apply to me at all*, 3 = *applied to me very much, or most of the time*). The DASS possesses high internal consistency (Lovibond & Lovibond,

1995). Cronbach's alpha in the current sample was .90 for the depression subscale, .83 for the anxiety subscale, and .90 for the stress subscale.

**Emotion Regulation Questionnaire (ERQ).** The ERQ (Gross & John, 2003) was administered to index the tendency to use reappraisal and suppression in order to regulate emotions. Participants rated the extent to which they agreed with statements such as '*I control my emotions by not expressing them*' on a 7-point scale (1 = strongly disagree, 4 = neutral, 7 = strongly agree). Test-retest reliability across three months was found to be 0.69 for both scales (Gross & John, 2003). In the current sample, Cronbach's alpha for the reappraisal subscale was .83 and was .74 for the suppression subscale.

**Emotion Regulation Implicit Association Test (ER-IAT).** We employed the ER-IAT used by Mauss, Evers, Wilhelm, and Gross (2006) as a means by which to index the extent to which participants held positive implicit attitudes toward emotion regulation. Participants were presented with emotion regulation words (e.g., *controlled*, *contain*), emotional expression words (e.g., *expressive*, *emotional*), positive words (e.g., *pleasant*, *good*), and negative words (e.g., *negative*, *bad*). They were instructed to categorise each word as fast as possible into the good/bad categories by pressing the 'E' or the 'I' key of the keyboard without making mistakes.

The ER-IAT consisted of five blocks. Blocks 1, 2 and 4 were practice blocks consisting of 20 trials each. In Block 1, participants were asked to categorize the emotion regulation words versus the emotional expression words. In Block 2, participants were asked to categorize the positive words versus the negative words. In Block 3, participants were asked to categorize emotion regulation words with the positive words versus the emotional expression words with the negative words (20 practice trials followed by 40 critical trials). In Block 4, participants were asked to categorize the emotion regulation versus emotional expression words again, but now with switched key assignments. In Block 5, participants



were asked to categorize emotional expression words with positive words versus emotion regulation words with negative words (20 practice trials and 40 critical trials) using the key assignments of Block 4. If participants gave an incorrect answer an X appeared on the screen until they pressed the correct key.

Each participant's ER-IAT score ( $D$ ) was calculated according to the procedure described by Greenwald, Nosek, and Banaji (2003). All trials with a response latency greater than 10,000 ms were removed from the dataset. For each participant, the  $SD$  across trials was calculated to adjust for latency variance. The average response times were then divided by this  $SD$ . Participants' final score consisted of the product of subtracting the averages in Block 3 from the averages in Block 5. A higher score represented an implicit preference for emotion regulation versus emotional expression.

**Cognitive bias modification (CBM).** A CBM training procedure was used to induce positive versus negative beliefs about the use of rumination, both in general, and specifically in response to anger. Specifically, positive beliefs were induced by items promising positive outcomes of the use of rumination (e.g., 'Analysing myself when I'm angry helps me to problem solve'). The negative beliefs were induced using items that advocated the absence of positive outcomes of ruminating (e.g., 'Analysing myself when I'm angry never helps me to problem solve'). The CBM procedure consisted of a training phase followed by a recognition test to assess whether the intended bias was induced, following the procedures of Mathews and Mackintosh (2002) and Woud et al. (2012).

**Training phase.** The items in the CBM task were based on items related to rumination used in two previous CBM studies (Lang, Moulds, & Holmes, 2009; Woud et al., 2012), items from the Positive Beliefs about Rumination Scale (PBRs; Papageorgiou & Wells, 2001), and items from the revised version of the PBRs (Watkins & Moulds, 2005).

Participants read a description of the process of rumination, and were then instructed that they would next be presented with '*a series of statements which relate to thoughts and feelings people may have regarding rumination*'. They were asked to imagine themselves in each statement as vividly as possible. Statements always appeared on the screen in two parts. The first part remained on screen for 2s. The second part then appeared on screen with one or more words from which a letter was missing. Participants were asked to press a button on the keyboard when they knew what the first missing letter was, and then to type that letter. The completed sentence was shown on the screen. The content of the statement formed either a positive or a negative belief about rumination depending on experimental condition.

The training phase consisted of 72 target statements and 8 filler statements. These were presented in eight Blocks of 10 statements each. Each block contained 9 rumination target statements and 1 filler statement. To ensure active encoding of the meaning of the statements, randomly selected statements (4 in each Block) were followed by a comprehension question. The program provided feedback on each answer by displaying '*correct!*' or '*incorrect!*'. The comprehension questions were formulated in such a way that the correct answer was '*yes*' 50% of the time in both experimental conditions.

To illustrate, an example of a target statement was '*Analysing myself when I'm angry*' followed by '*helps me to pr\_blem solve*' in the positive beliefs condition or '*never helps me to pr\_blem solve*' in the negative beliefs condition. The related comprehension question was '*Does analysing when you are down help you problem solve?*' An example of a filler statement is '*I am always thinking about*' followed by '*s\_mething*'. Crucially, filler items did not directly refer to outcomes of rumination, whereas the target items did.

***Test of induced bias.*** Following the procedure of Mathews and Mackintosh (2000) and Woud et al. (2012), the assessment of the bias induction included an encoding and a recognition stage. During the encoding stage, participants were presented with one practice

scenario about a family picnic in the park, followed by 10 new critical statements about the use of rumination. In contrast to items from the training phase, these 10 statements remained neutral in terms of whether or not rumination was favoured (e.g., *'If I'm feeling angry, it is best to try to react in a way that is appropriate'*). Each statement was preceded with a brief title (e.g. *'Reacting to anger'*). Participants were asked to imagine themselves in the statements as vividly as possible and to rate the vividness on a 5-point scale (1 = *not at all vivid*, 5 = *extremely vivid*).

In the recognition phase participants were presented with the statement titles (e.g., *'Reacting to anger'*). Each title was presented with four statements. Participants were asked to rate the similarity of each statement with the original statement from the encoding phase on a 4-point scale (1 = *very different in meaning*, 4 = *very similar in meaning*). Critically, the four statements consisted of a positive belief about rumination (e.g., *'If I'm feeling angry, it is best to analyse the situation to try to come up with a solution'*), a negative belief about rumination (e.g., *'If I'm feeling angry, it is best to never analyse the situation to try to come up with a solution'*), a positive foil including rumination (e.g., *'If I'm feeling angry, it is best to analyse how I'm lucky to have had very few problems with my friends'*) and a negative foil including rumination (e.g., *'If I'm feeling angry, it is best to analyse all of the problems I've ever had with my friends'*). The foil items were included to check whether any biases that were observed following the CB training were specific to beliefs about rumination or rather reflected a general positivity or negativity bias. Although all items refer to rumination, the crucial difference here is that the target items refer to a *consequence* of rumination (i.e., a specific belief about rumination) whereas the foil items do not.

**Aggressive Provocation Questionnaire (APQ).** The APQ (O'Conner, Archer, & Wu, 2001) was used to measure aggressive feelings and responses towards anger-invoking scenarios. The APQ consists of 12 anger provoking scenarios (e.g., people making noise and

kicking your chair at the cinema). In the present study, the APQ was modified so as to be relevant to an Australian undergraduate sample. Accordingly, 7 scenarios were excluded that described work situations (because our participants were students), routine driving (because the participants were unlikely to have their own car), or family situations (because the participants were unlikely to be married with children).

Participants were asked to imagine themselves in the situation and then rated how angry, frustrated and irritated they would feel in that situation on a 5-point scale (0 = *not at all*, 4 = *extremely*). Next, participants were asked what they would do in that situation by selecting one of five options, representative of the following categories: (i) avoiding the situation, denying that something is wrong, or transforming it into something positive; (ii) doing nothing, although feeling angry; (iii) distant anger, indirect or delayed angry behaviour; (iv) assertive behaviour, confronting the provoking person but without overt verbal or physical aggression; (v) aggressive behaviour, direct verbal or physical aggression. The options were presented in random order of category following Van Goozen, Frijda, Kindt, and van de Poll (1994). The responses to this ‘action’ item can be analysed as a single dimension on one ordinal anger-readiness scale (Van Goozen et al., 1994), or the number of assertive and aggressive behaviours (response categories iv and v, respectively) can be analysed in two separate ordinal variables (O’Connor et al., 2001).

In order to increase the number of items, an additional scenario taken from DeWall, Baumeister, Stillman, and Gailliot (2007) was included. This scenario describes a stranger engaging in flirtatious behaviour with the participant’s (hypothetical) partner which is reciprocated by him/her, resulting in aggressive behaviour of the stranger towards the participant. Participants were asked to rate how likely it was that they would smash a nearby beer bottle on the stranger’s head (-5 = *not at all likely*, 0 = *neither likely nor unlikely*, 5 = *extremely likely*). Other minor edits were made to the wording of some scenarios in the APQ

to reflect more common Australian language use (e.g., ‘*lads*’ was translated to ‘*young boys*’). In the current sample, Cronbach's alphas for the 5 APQ scenarios that were included were 0.75 for the anger scale, 0.79 for the frustration scale, and 0.79 for the irritation scale.

## **Procedure**

All participants were tested individually. They provided informed consent and completed the ERQ, DASS and the ER-IAT. They were then randomly assigned to either the positive beliefs or the negative beliefs about rumination condition. Participants completed the CBM training followed by the encoding and recognition assessment phases, after which they completed the APQ. Finally, they were debriefed, thanked for their time and assigned course credit. The ERQ, DASS and APQ were presented using Medialab software (version 2008.1.20; Jarvis, 2007), the ER-IAT was presented using Inquisit software (version 2.0.6; 2008) and the CBM procedure was presented using E-Prime (version 1; 2002).

## **Results**

### **Statistical approach**

Group differences were tested with *t*-tests unless otherwise specified. All tests were two-tailed with a significance level of .05. Table 1 provides the means and standard deviations for all measures within and across experimental groups. Effect sizes are reported in Cohen's *d*.

### **Randomisation checks**

There was no significant difference between the experimental groups in age,  $t(97) = 0.29, p = .77$ , or gender distribution,  $\chi^2(1) = 0.02, p = .88$ . There were also no significant differences between experimental groups on the ERQ reappraisal,  $t(97) = 0.21, p = .84$ , and the ERQ suppression subscale,  $t(97) = 0.73, p = .47$ . There were no significant group differences on the DASS depression,  $t(97) = 1.44, p = .15$ , or DASS stress subscales,  $t(97) = 0.86, p = .39$ ; however, participants in the negative beliefs condition reported significantly

higher levels of anxiety on the DASS than participants in the positive beliefs condition,  $t(97) = 2.16, p = .03, d = .43$ .

In relation to implicit evaluations for the expression versus regulation of emotions (ER-IAT), the difference between the positive and negative belief condition approached significance,  $t(97) = 1.95, p = .06$ .

\*\*\* Table 1 around here \*\*\*

### **CBM manipulation check**

A ‘rumination bias’ was calculated by subtracting the average similarity ratings for negative target items from those for positive target items from the CBM recognition phase. A negative index would thus indicate a bias towards negative beliefs about rumination whereas a positive index would indicate a bias towards positive beliefs about rumination. In order to rule out the possibility that the trained bias was a general valence bias rather a specific rumination bias, the average similarity ratings of the negative foil items were subtracted from those of the positive foil items. A positive index thus reflected a positivity bias whereas a negative index reflected a negativity bias.

There was no significant difference between the experimental groups on the general valence bias,  $t(97) = 0.19, p = .85$ , showing that the CBM effects could not be explained merely by a general positivity or negativity bias. Critically, participants in the positive beliefs condition showed a stronger bias towards endorsing positive beliefs about rumination than participants in the negative beliefs condition,  $t(97) = 3.81, p < .001, d = .76$ , although the average bias index for both groups was in the positive direction.

For both experimental groups, the rumination bias (positive beliefs:  $t(48) = 15.52, p < .001$ ); negative beliefs:  $t(49) = 8.68, p < .001$ ), as well as the general valence bias (positive

beliefs:  $t(48) = 8.70, p < .001$ ; negative beliefs:  $t(49) = 8.29, p < .001$ ) were significantly different from zero and in the positive direction. That is, in both conditions a bias was found towards endorsing positive beliefs about rumination over negative beliefs, but this bias was stronger in the positive beliefs condition than in the negative beliefs condition.

### **Experimental effects of CBM training on anger<sup>3</sup>**

Opposite to prediction, participants in the positive beliefs condition reported that they would experience lower levels of anger in response to the APQ scenarios than participants in the negative beliefs condition,  $t(97) = 2.58, p = .01, d = .52$ . There were no significant differences between the two conditions in the APQ scores for frustration, irritation, or action (dimensional), nor in the likelihood score of smashing the bottle in the additional scenario, smallest  $p > .20$ . Analysing the number of assertive and aggressive responses on the APQ action items in separate ordinal variables also did not result in any significant differences:  $t(97) = 1.53, p = 0.13$ , and  $t(97) = 1.42, p = 0.16$ , respectively.

**CBM effects controlling for anxiety and ER-IAT scores.** The two experimental groups were significantly different in baseline anxiety (DASS) and there was a trend towards a between-group difference in baseline ER-IAT scores, which may have accounted for the differential CBM effects on APQ anger scores. To rule out this alternative explanation, a univariate ANCOVA was conducted with condition (positive beliefs, negative beliefs) as the independent variable, APQ anger scores as the dependent variable, and DASS anxiety and ER-IAT scores as covariates. Overall, the analysis was significant,  $F(3, 95) = 4.78, p < .01$ . DASS anxiety was not a significant predictor of APQ anger scores,  $F(1, 95) = 1.51, p = .22$ , but ER-IAT scores were,  $F(1, 95) = 5.42, p = .02, d = .48$ . Controlling for these covariates, the effect of CBM condition was reduced to a trend approaching significance,  $F(1, 95) = 3.40, p = .07$ .

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<sup>3</sup> There was no significant interaction between the experimental conditions and gender for APQ scores; accordingly, in all analyses, the data were collapsed across male and female participants.

## Discussion

We tested the hypothesis that beliefs about rumination influence predicted levels of anger and aggression in response to anger-provoking situations. In contrast to our prediction, participants in the positive beliefs condition predicted that they would feel less angry in response to the anger-provoking scenarios than participants in the negative beliefs condition. However, when implicit preferences for emotion expression (i.e., the ER-IAT scores) were entered as a covariate, the strength of this effect was reduced to a trend. To the extent that engaging in rumination may map on to a preference for emotion regulation, it appears that the CBM training was unable to entirely overrule the influence of personal preferences in emotional regulation on anger. However, a link between implicit emotion regulation preference and rumination is not straightforward and therefore, at this stage, we can only speculate as to why implicit preferences in emotional regulation reduced the experimental effect to a non-significant trend.

Although the effect of beliefs about rumination on predicted anger responses was only marginally significant, the fact that the group means were in the opposite direction than expected warrants discussion. First, participants in the positive beliefs condition were trained to believe that rumination would be a helpful strategy in response to anger-provoking situations. As a result, participants in this condition may have expected to feel less angry in response to the scenarios described in the APQ. Indeed, meta-cognitions about rumination could include the expectation that engaging rumination will prevent one's feelings of anger from escalating (Simpson & Papageorgiou, 2003). Another possibility is that in the current study, rumination in response to anger actually reduced anger, although given that previous research has repeatedly found that engaging in rumination exacerbates anger responses (Bushman, 2002; Denson et al., 2006; Denson et al., 2012), this seems unlikely. Therefore, we suggest that it is seems more plausible to interpret the current findings in light of a



dissociation between beliefs about rumination and expected anger responses on the one hand, and active engagement in rumination and actual anger responses on the other.

Interestingly, participants in the positive beliefs condition as well as the negative beliefs condition showed a positive belief bias towards rumination, although the bias was more pronounced in the former group. This suggests that, at least in a population of first year psychology students, there may be a general belief that analysing the causes and meanings of an angry mood state is beneficial. A possible reason as to why participants in the negative beliefs condition did not show a negative bias towards rumination is that the CBM training items may have been more ambiguous in this condition than in the positive beliefs condition. For example, in response to the target statement '*Analysing myself when I'm angry*' participants in the positive beliefs condition received the sentence '*helps me to pr\_blem solve*', thereby clearly indicating the message that ruminating is a good thing to do. In contrast, the sentence '*never helps me to pr\_blem solve*', which participants in the negative beliefs condition received, could feasibly have been perceived to be more ambiguous about whether rumination is actually harmful or whether it is merely ineffective.

There are a few limitations that need to be discussed. First, participants rated their predicted responses to hypothetical anger-provoking scenarios but were not actually provoked into an angry mood state. However, previous research suggests that individual differences in risk for perpetrating aggression is consistently positively related to predicted aggressive reactions in response to scenarios such as those used in the present research (e.g., O'Connor et al., 2001; Pardini, Lochman, & Frick, 2003; Marsee & Frick, 2007; Tremblay & Ewart, 2005). Second, no measure of rumination was included and therefore it is unclear whether participants actually engaged in rumination in response to the anger-provoking APQ scenarios or not. That is, we cannot assume that participants' predicted responses would reflect their actual responses when provoked into an angry mood state. Future studies should

therefore include an actual anger-provoking situation (e.g., Denson, Grisham, & Moulds, 2011) and also measure the extent to which participants report that they engage in rumination during this situation in order to overcome these limitations.

A third limitation was that although the CBM items in the positive beliefs condition clearly conveyed the message that rumination is beneficial, the items for the negative beliefs condition merely stated that rumination is not beneficial. Future studies should therefore include CBM items that clearly convey a stronger negative message about rumination in the negative beliefs condition and consider including an additional control condition in which a different strategy is being promoted in the CBM training (e.g., distraction; Rusting & Nolen-Hoeksema, 1998; Denson et al., 2012). The inclusion of such a control condition would also clarify whether the positive belief bias in our negative beliefs condition was reduced, the positive belief in our positive beliefs condition was increased, or both.

Similarly, social desirability could have influenced participants' responses as the purpose of the training may have been obvious, especially in the positive beliefs condition. This is an issue that affects most CBM studies because including foil items to mask the purpose may also weaken the strength of the bias induction. Therefore future studies might consider asking participants about their perceived goal of the study and their predictions for the effect of the CBM procedure. This would allow for statistically controlling for demand and social desirability effects.

If CBM is further refined and demonstrated to have efficacy in modulating key emotion-related beliefs, there may be important clinical applications. For example, Lang, Moulds, and Holmes (2009) used this procedure to target appraisals of the meaning and content of intrusive memories of a sadness-inducing personal event. Participants were randomly assigned to adopt either adaptive or maladaptive appraisals of the experience of intrusive memories (e.g., adaptive: 'having an intrusive memory means that nothing is wrong

with me’; maladaptive: ‘having an intrusive memory means that something is wrong with me’). Participants were then presented a series of depressive film-clips that included scenes of bullying and bereavement. Participants in the adaptive appraisal condition reported fewer intrusive memories of the film over the subsequent week, and less distressing intrusions in response to an intrusion provocation provoking task in the laboratory one week later.

Similarly, Woud, Holmes, Postma, Dalgleish, and Mackintosh (2012) used CBM to target maladaptive appraisals of the meaning and content of intrusive memories of a distressing experience. Participants were trained to adopt either maladaptive appraisals of intrusive memories that are characteristic of posttraumatic stress disorder (PTSD) or alternative positive appraisals, and were then presented with a film showing scenes of potential traumatic events (e.g., terrorist attacks, and traffic accidents) as an analogue for trauma. Participants who received the positive appraisals training reported less frequent intrusive memories of the film over one week than those in the negative appraisals condition. Taken together, the findings of these two studies demonstrate that adaptive metacognitive appraisals can be effectively trained using CBM procedures, and furthermore, that experimentally training positive appraisals can have adaptive psychological consequences.

Successful CBM training aimed at reducing beliefs that may indirectly result in anger would be helpful in the treatment for individuals with anger management problems. Because individuals with clinically significant anger problems often have trouble identifying their angry state before their anger escalates, it may be helpful to modify beliefs about responses in order to change their immediate reactions to provocations. Conversely, we speculate that it might be possible that a successful CBM training aimed at training beliefs that will give rise to increases in anger might be useful for individuals who would likely benefit from assertiveness training. That is, despite the adverse outcomes of anger outlined earlier in this paper, we note literature that has demonstrated that under some circumstances, anger can

facilitate beneficial outcomes. For example, anger can help in achieving one's goals (Aarts et al., 2010; van Kleef, de Dreu, & Manstead, 2004), can make people less pessimistic about the future (Lerner, Gonzales, Small, & Fischhoff, 2003), help communicate needs in social relationships (Baumeister, Stillwell, & Wortman, 1990), and help people perform better in confrontational tasks (Tamir, Mitchell, & Gross, 2008).

To summarize, we found that CBM training of positive and negative beliefs about rumination effectively changed beliefs about rumination and participants' expected responses to anger-provoking situations. In contrast to our hypothesis, participants in the positive beliefs condition expected to feel less angry in anger-provoking situations than participants in the negative beliefs condition (although this effect was only significant at trend level after controlling for implicit attitudes towards emotional expression versus suppression). The direction of the effect on beliefs and the translation from hypothetical scenarios to real-life anger provoking situations remains unknown. This study was the first to bring together the research fields of anger, rumination, and CBM training of beliefs about rumination. We have offered several concrete suggestions for future studies that we hope will further research in this area. Finding new ways to change beliefs about rumination in response to anger, e.g., through CBM training, may prove to have clinical benefits for individuals with anger management problems and individuals who find it hard to be assertive in social interactions. Professor Nolen-Hoeksema's theory, methodologies and empirical findings have shaped the literature and our understanding about the role of rumination in depression. Such is the extent of her influence across the field of psychology that her work will without doubt continue to critically inform how we approach outstanding questions about the consequences of rumination across emotional states, including anger.

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Table 1. Means and standard deviations for all measures between and across experimental groups.

		Positive beliefs		Negative beliefs	
		(n = 49)		(n = 50)	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Age		19.22	2.72	19.10	1.28
ERQ	Reappraisal	4.94	1.06	4.90	0.95
	Suppression	3.64	1.27	3.47	1.09
DASS	Depression	1.42	0.42	1.54	0.47
	Anxiety	1.33	0.31	1.48	0.38
	Stress	1.74	0.48	1.83	0.55
ER-IAT		-0.37	0.42	-0.20	0.48
CBM bias	Rumination	1.84	0.83	1.16	0.95
	General valence	0.58	0.47	0.60	0.51
APQ	Anger	3.41	0.69	3.78	0.72
	Frustration	3.42	0.73	3.53	0.95
	Irritation	3.57	0.81	3.78	0.81
	Action (dimensional)	2.98	0.55	2.95	0.57
	Action (assertive)	2.16	1.12	2.52	1.20
	Action (aggressive)	0.37	0.70	0.20	0.45